REMARKS

Examiner M. Guerrero is thanked for the thorough examination and search of the subject Patent Application. Claims 1, 6, and 14 have been amended. No new matter has been added.

All Claims are believed to be in condition for Allowance, and that is so requested.

Reconsideration of the rejection under 35 U.S.C. 102 of Claim 1 as being anticipated by Babcock et al is requested in view of amended Claim 1 and in accordance with the following remarks.

It is agreed that Babcock et al forms LDD and source and drain regions adjacent to the gate electrode. Babcock et al teaches depositing a carbon-doped silicon layer 160 on a substrate 10 and growing an epitaxial layer 170 over it. In paragraph [0015], it is taught that the thickness of the source and drain regions 80 is determined by the distance W (Fig. 2b) of the carbon-doped layer 160 from the substrate surface. This would suggest that for all deposited carbon in this invention, it was intended that the carbon layers do not lie within the source and drain region. Claim 1 has been amended to claim the implantation of the source and drain regions 26 extending through the carbon-doped region 12 and into the bulk silicon substrate 10, as taught at the top of page 11 of the Specification. This is clearly different from the source and drain profile of Babcock et al.

Furthermore, the embodiment in which Babcock et al forms halo implants is an alternative embodiment of their invention, described in paragraph 0017 and shown in Figs. 4a and 4b. In this embodiment, the carbon-doped layer is not deposited on silicon followed by the growth of an epitaxial silicon layer. In this embodiment, the carbon-doped layer 195 is implanted under the gate structure followed by halo implantation 190, resulting in the carbon-doped layer's encapsulating the halo implant. Thus, Babcock et al does not teach depositing a carbon-doped layer on a silicon substrate, growing an epitaxial silicon layer over the carbon-doped layer, and forming halo implants in the epitaxial silicon layer where the halo implants extend to an interface between the epitaxial silicon layer and the carbon-doped layer, as claimed in Claim 1. At the end of paragraph 0017, it is noted that this embodiment can be combined with the previous embodiment to include a carbon-containing layer beneath the source/drain region 200. If this carbon-containing layer is included, it still would not anticipate Applicants' invention because, as shown in Fig. 4b, the halo implants 190 are encapsulated by the implanted carbon-doped layer 195. The halo implants 190 would not extend to the deposited carbon-doped layer 160 below regions 200. It is also described in paragraph [0019] and explicitly illustrated in Figs. 6(a) and 6(b), where the invention teaches the implantation of a "deep halo" region in the presence of a deposited carbon. It is mentioned that the halo region is to be located beneath the carbon capping layer and therefore, also beneath the source and drain regions. Hence the invention does teach a method to form the halo, but involves a region whereby the overlap between the carbon profile and the implant profile is avoided.

Reconsideration of the rejection under 35 U.S.C. 102 of Claim 1 as being anticipated by Babcock et al is requested in view of amended Claim 1 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1, 3, 5-7, 9, 11-12, 14, 16, 18-19, and 26-27 as being anticipated by Mansoori et al is requested in view of Amended Claims 1, 6, and 14 and in accordance with the following remarks.

The claims have been amended to make it clear that the halo implants 30 extend downward through the epitaxial silicon layer 14 to the interface of the epitaxial silicon layer with the carbon-doped layer, as shown in Fig. 3. It is critical that the carbon-doped layer 12 lies at the silicon interface of the halo doping profile (page 9) to prevent end-of-range secondary defects associated with the halo implant. In Applicants' invention, the carbon-doped layer is intentionally directed away from the transistor channel region. This is to avoid undesirable electrical effects which may result from the presence of carbon in the transistor channel. Due to processing and fundamental concerns, carbon may exist in the form of interstitials in silicon and this degrades the drive current of the transistor when located nearer to the channel region. Another purpose of partially overlapping the implant profile is in order to conserve the usual dopant activation scheme. This is to simplify the fabrication of the transistor such that the dopant activation kinetics in silicon, which has been well understood, may be applicable.

Mansoori's halo implants 152 (Fig. 15) are implanted within the carbon-doped layer 104, not within the epitaxial silicon layer 108. Thus, the location of the carbon-doped layer beginning

at the end-of-range of the halo implant doping profile is not taught by Mansoori et al. No details of the halo implant are provided. Heavy ions for the halo implant are not disclosed in Mansoori et al. The claims have also been amended to claim the implantation of the source and drain regions 26 extending through the carbon-doped region 12 and into the bulk silicon substrate 10, as taught at the top of page 11 of the Specification. Mansoori's source and drain regions 158 do not extend through the carbon-doped region 104 to the bulk silicon substrate 102 (see Figs. 16-17).

Reconsideration of the rejection under 35 U.S.C. 102 of Claims 1, 3, 5-7, 9, 11-12, 14, 16, 18-19, and 26-27 as being anticipated by Mansoori et al is requested in view of Amended Claims 1, 6, and 14 and in accordance with the remarks above.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 2, 4, 8, 10, 15, and 17 as being unpatentable over Mansoori et al in view of Takahashi is requested in view of Amended Claims 1, 6, and 14 and in accordance with the following remarks.

Takahashi shows depositing a carbon-containing polycrystalline layer. Since Takahashi's carbon-doped layer is deposited on a polycrystalline silicon layer, it will be polycrystalline in structure, rather than monocrystalline as are the layers of Mansoori et al and the Applicants' invention. Also, Takahashi's layer is used to prevent thermal diffusion "solely on the polycrystalline silicon layer 22" underlying the carbon-containing layer 24 (col. 5, lines 62-67). The carbon-containing layer 24 becomes part of a gate electrode as shown in Fig. 3. This has nothing to do with Applicants' invention or with Mansoori et al. While it is agreed that

Takahashi teaches depositing a carbon-doped silicon layer by reduced pressure vapor deposition, it is not agreed that there would be any motivation to combine Takahashi with Mansoori et al because their carbon-doped layers are used for entirely different purposes and the crystal structure and location of the carbon layers are different. Since Takahashi's carbon-doped layer is deposited on a polycrystalline silicon layer, it will be polycrystalline in structure, rather than monocrystalline as are the layers of Mansoori et al and the Applicants' invention. Furthermore, Mansoori et al teaches that the carbon-containing layer may be formed by any technique including implanting carbon in the wafer or growing a carbon-containing layer over the semiconductor body. This teaches away from Applicants' invention since Applicants have found that implanting carbon can cause damage at the tail end of the implantation profile (see the discussion in the paragraph bridging pages 8 and 9). Thus, Applicants' invention is not taught or suggested by the combination of references.

Reconsideration of the rejection under 35 U.S.C. 103 of Claims 2, 4, 8, 10, 15, and 17 as being unpatentable over Mansoori et al in view of Takahashi is requested in view of Amended Claims 1, 6, and 14 and in accordance with the remarks above.

Allowance of all Claims is requested.

It is requested that should Examiner Guerrero not find that the Claims are now Allowable that the Examiner call the undersigned at 765 4530866 to overcome any problems preventing allowance.

Respectfully submitted,

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